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ABSTRACT

This paper reports a subset of findings from an extensive investigation of preservice elementary teachers' (n=61) beliefs about and knowledge of alternative mathematics assessment. These preservice teachers, who enrolled in a mathemnatics methods course, responded individually to four mathematics assessment surveys, participated in three paired mathematics assessment activities, and developed an alternative assessment project. This study explored a wide range of issues related to mathematics assessment. Findings reported herein include those related to (1) beliefs about mathematics assessment, (2) the extent to which various alternative assessment techniques can provide important information about students' mathematical learning, and (3) the role of Assessment Standards (NCTM, 1995) in mathematics assessment practice. Contains 10 references. (Author/AIM)

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THE DEVELOPMENT OF PRESERVICE ELEMENTARY TEACHERS' BELIEFS ABOUT AND KNOWLEDGE OF ALTERNATIVE MATHEMATICS ASSESSMENT

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THE DEVELOPMENT OF PRESERVICE ELEMENTARY TEACHERS' BELIEFS ABOUT AND KNOWLEDGE OF ALTERNATIVE MATHEMATICS ASSESSMENT

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This paper reports a subset of findings from an extensive investigation of 61 preservice elementary teachers' beliefs about and knowledge of alternative mathematics assessment. These preservice teachers, who enrolled in a mathematics methods course, responded individually to four mathematics assessment surveys, participated in three paired mathematics assessment activities, and developed an alternative assessment project. This study explored a wide range of issues related to mathematics assessment. Findings reported herein include those related to (a) beliefs about mathematics assessment, (b) the extent to which various alternative assessment techniques can provide important information about students' mathematical learning, and (c) the role of Assessment Standards (NCTM, 1995) in mathematics assessment practice.

A strong movement for change in mathematics assessment has emerged (Kulm, 1990; National Council of Teachers of Mathematics [NCTM], 1995; Webb, 1993). Broadly viewed as a tool used by teachers to help students achieve educational goals (Webb, 1993), assessment in mathematics is no longer a matter of counting right and wrong answers on tests. Because mathematics has historically been viewed as "readily amenable to breaking into nice, simple, linear pieces" (Kulm, 1990, p. 1), assessment of mathematics learning has taken the form of measuring whether or not specific behavioral objectives have been met. As a result, anything that could not be stated and measured behaviorally gradually disappeared from the curriculum. Today, as the mathematics curriculum projects a new philosophy of a dynamic mathematics curriculum, assessment of the learning of that curriculum has also become more dynamic. Consequently, as mathematics assessment practices change, it is imperative to consider how assessment must be seen as an integral part of instruction (Cooney, et al., 1993).

Assessment practices implemented by teachers send a powerful message to students about what types of mathematical thinking and mathematics content are valued. What gets assessed and how it gets assessed implicitly send signals to students about what teachers believe is important. Most often, teachers have not considered how their beliefs affect their teaching and assessment practices, nor have they reflected on how changes practice may run counter to students' expectations of mathematics practice (Borasi, 1990) and, as a result, affect their students' beliefs.

Many alternative assessment techniques have surfaced, including formal and informal student self-assessment, and assessment of mathematical problem solving (Moon & Schulman, 1995). These techniques offer both advantages and disadvantages in terms of time commitment, ease of implementation, and usefulness for assessing student learning. A major constraint to the implementation of alternative assessment techniques expressed by teachers is that the techniques often provide data that are difficult to interpret and are not useful for assigning grades. However, analytic and holistic scoring rubrics have been shown to alleviate these concerns (e.g., Stenmark, 1993).

This paper reports a subset of findings from an investigation of preservice elementary teachers' beliefs about and knowledge of alternative mathematics assessment. The preservice teachers were involved in a number of mathematics assessment activities and explored a wide range of issues related to

mathematics assessment including (a) beliefs about mathematics assessment, (b) the extent to which various alternative assessment techniques can provide important information about students' mathematical learning, and (c) the role of *Assessment Standards* (NCTM, 1995) in mathematics assessment practice.

Methods

Participants and Data Collection

The participants in the study include 61 perservice elementary teachers enrolled in three different sections of a semester-long elementary mathematics methods course at a midwestern university. These students were college seniors engaged in their final semester of coursework prior to student teaching. All of the students completed a series of individual surveys and paired mathematics assessment tasks. However, eight of these students volunteered to be videotaped while engaged in the paired mathematics assessment activities and to partake in an individual audiotaped interview at the end of the semester. All eight volunteers were women between the ages of 21 and 24.

Data were collected from the larger set of participants via four intermittent questionnaires, three assessment activities, and an alternative assessment project. The first survey, a multiple choice Mathematics Beliefs Survey (MBS), was given on the first day of the semester. Subsequent surveys, including an open-ended Mathematics Assessment Beliefs Survey (MABS), an open-ended Alternative Mathematics Assessment Techniques Survey (AMATS), and short-answer/open-ended Mathematics Assessment Standards Survey (MASS), were implemented throughout the semester prior to the coverage of the topic of "mathematics assessment" in the methods course. The three paired assessment tasks engaged the 61 students in (a) distinguishing between "closed" versus "open" mathematical tasks, (b) identifying children's mathematical computation errors, and (c) scoring children's mathematical problem solving via analytic and holistic scoring rubrics. While the rest of the participants were engaged in these activities during class time, the four volunteer pairs were excused and videotaped separate from the rest of class. The researcher elicited a brief videotaped conversation with the four volunteer pairs about the activities upon the completion of each of the tasks.

An additional source of data on the development of students' beliefs and knowledge about mathematics assessment was a class assignment in which all students designed two mathematics assessment instruments, constructed concept maps of "mathematics assessment," and discussed issues related to mathematics assessment. A final source of data were the final individual audio-taped interviews (approximately one hour) with each of the eight volunteer participants. Data were initially viewed by total participant response to surveys and assessment tasks. Later, the eight volunteers' individual cases were examined both on a case by case basis, incorporating data gathered from the paired interactions. In the following sections I report some of the findings from the initial analysis of whole-class survey data, highlighting specific insights from some of the preservice teachers.

Initial Findings

Beliefs About Mathematics Assessment

On the MBS instrument, the preservice teachers were asked 77 questions related to their mathematics belief system including beliefs about the nature of mathematics and mathematics pedagogy. Twenty-one of those questions related specifically to their beliefs about mathematics assessment. Table 1 illustrates the students' responses some of those questions.

Table 1

Percent of students who responded agree or strongly agree to the given assessment statement.

Assessment Statement	Percent Agreed or Strongly Agreed
Written tests are the best means of assessing student progress in mathematics.	18.3
In assessing mathematics, credit should be given to student who solve problems using appropriate method but which differ from the methods provided during instruction.	54.0
Mathematics assessment should include determining students' ability to reason and analyze.	95.1
Mathematics knowledge should be assessed individually.	80.4
Students' can assess their own mathematical knowledge.	73.8
Periodic chapter tests are the best means of assessing mathematical learning.	16.4
Mathematics will be easier to assess than language arts.	41.0
Assessing mathematical understanding is easy.	16.4
Assessment of students' mathematical knowledge should yield information about their disposition (attitudes, preferences, etc.) toward mathematics.	34.3
It is important to assign students a number of problems to work in order to practice new mathematical concepts they have been taught	73 3
Group tests in mathematics can tell you a lot about students' mathematical understanding.	23.0

The percentages of responses by preservice teachers are not too surprising, particularly the beliefs that students' mathematical knowledge should be assessed individually and that it is important to assign a number of problems to practice mathematical skills taught. Also it is encouraging that many of the preservice teachers indicated that assessment should determine students' ability to reason and analyze and that students' should be able to assess their own mathematical knowledge.

In elaborating on these survey responses via the MABS instrument, preservice teachers suggested a wide range of responses to what they believed was the best way to assess mathematics, reporting:

- *I feel pre and post tests can be very effective*
- *through observing their problem solving techniques*
- *writing; if they can write out an answer and show that they understand, then it shows learning*
- *this could be different for each one of my students*
- *in-class work that the students do*
- *by asking them to put down how they came up with their answers*
- *through portfolios so you see how they have improved from the beginning of the year on*
- *I believe that you should use multiple ways*

Only 16.4 % reported believing that mathematics assessment would be easy and 41% thought mathematics assessment would be easier than language arts assessment. When asked if mathematics assessment was the same or different from assessment in other content areas, preservice teachers claimed:

- *math is generally not as subjectively graded. Often times there may be many ways to get an answer but there is only one correct answer. Language Arts is not so clearly right or wrong*
- *I think it is the same in the respect that you are assessing ability and prior knowledge It is different because the content is just different. For example, math is a good subject to do hands on assessing. Other subjects hands-on doesn't seem as practical*
- *math assessment is different than in reading, spelling or social studies. In math students are solving more problems and using more contemplative thought processes*
- *math is more right and wrong with no in-betweens; answers are not opinions*
- *in math you have to understand a lot before you can go on to other problems; you have to know the basics (addition, subtraction, multiplication, and division)*
- *I believe math assessment is becoming similar to other content areas because of the push for writing in math;*

Viewed in conjunction with other expressed beliefs about the nature of mathematics and mathematics pedagogy, these preservice elementary teachers hold a typical range of beliefs about mathematics and mathematics pedagogy (see Raymond, 1996; Thompson, 1992). Because expressed beliefs are not always consistent with teaching practices, and are often challenged in the face of practice (Raymond, in press), it is vital in understanding the development of assessment beliefs to gain a sense of the preservice teachers' knowledge and interpretations of alternative mathematics assessment practices.

A Critique of Various Alternative Mathematics Assessment Techniques

On the AMATS instrument, pairs of students discussed and reported what they believed one could learn about children's mathematical understanding from a variety of mathematics assessment techniques including (a) open-ended problem-solving tasks, (b) quizzes, (c) portfolios, (d) journal writing, (e) teacher observations, and (f) standardized testing. From *problem-solving tasks* the preservice teachers determined that one could learn many things about students including information about how students think, levels of understanding, students' organizational skills, group dynamics, mathematical reasoning and logic, critical thinking skills, different methods children use to solve problems, thinking patterns, students' ability to solve problems, students' knowledge of problem solving and problem-solving strategies, how they apply math knowledge to real world situations, communication skills and creativity. Regarding what the preservice teachers thought they could learn from mathematical *quizzes*, the list is much different. They suggest quizzes demonstrate student recall, understanding of concepts, long and short-term memory, knowledge in particular content areas or section, how well a teacher is teaching, student learning or review of basic concepts, facts, and skills, and how students follow instructions.

As to the benefits and purposes of student *journal writing* in mathematics, the preservice teachers suggested that through student writing they could learn about students' ability to reflect; how students think; individual understanding; student opinions; and writing skills and how well they verbalize. They also believed that journal writing allows students to take responsibility for their own work; to record ideas, feelings, successes and failures; to express both attitude and comprehension; to communicate with the teacher; and to review prior writing about their thinking.

In brief, the preservice teachers demonstrated that they could identify differences between alternative mathematics assessment techniques and the kinds of information about students' learning that one can glean from them. They claimed that having been asked to discern what could be learned from different assessment techniques served to make clear the need for alternative assessment practices.

The Role of Mathematics Assessment Standards

On the MASS instrument, preservice teachers were asked to rank order the six Assessment Standards (NCTM, 1995) from most important (1) to least important (6) according to what they believed was most important to consider when developing a good mathematics assessment plan. In addition to their written explanations of why they viewed one criterion as more important than another, the preservice teachers were later asked to discuss the extent to which different alternative mathematics assessment techniques have the potential to meet the six standards. Table 2 illustrates the preservice teachers' rankings of the NCTM's (1995) *Assessment Standards*.

Table 2.

Percentages of preservice teachers' rankings of the NCTM Assessment Standards from most important (1) to least important (6).

	Assessment Standard					
Ranking	Important Mathematics	Enhance Learning	Promote Equity	Openness	Validity	Consistency
1	15%	11%	40%	0%	25%	9%
2	9%	21%	15%	4%	13%	38%
3	19%	6%	11%	6%	45%	13%
4	8%	26%	6%	21%	15%	25%
5	28%	19%	26%	9%	2%	15%
6	23%	15%	2%	60%	0%	0%

Of primary concern to these preservice teachers were equity, consistency, and validity and of least concern was openness. Enhancement of learning and emphasis of important mathematics were rated as only moderately important.

Regarding equity, most students who selected this as the most important standard wrote that they believed all students should be given a fair chance to show they know the material. On the value of valid and consistent assessment practices, several students suggested, "if the assessment doesn't measure what you want it to, then it is worthless." Students who ranked openness as least important either reported that they were not sure what was meant by "all aspects of the mathematics assessment process should be open to review and scrutiny" (NCTM, 1995) or explained that willingness to allow your assessment practices to

be scrutinized was merely a guideline or choice to be made by the teacher, not an integral part of the assessment process.

Some preservice teachers explained their modest ranking of emphasizing important mathematics saying, "all mathematics taught should be important." One preservice teacher deduced, "you need to assess the mathematics that is taught, not the most important to learn." Although some preservice teachers expressed that enhancing learning was vital, others made statements such as, "assessment is to gather data about the students' learning and how they learn, NOT to enhance their learning."

Closing Remarks

The investigation explores both preservice teachers' knowledge base related to alternative mathematics assessment as well as their beliefs about mathematics assessment and its relationship to mathematics teaching practice. This research captures preservice teachers' thinking as they develop from students of the mathematics teaching-learning-assessment process to student teachers who must confront mathematics teaching, learning, and assessment issues on a daily basis.

Initial results of this study signify the importance of providing preservice teachers with a forum for discussing and engaging in alternative mathematics assessment practices. Left to interpretation, many of the overarching goals of mathematics assessment reform may be lost to preservice teachers. The examination of beliefs and current knowledge of alternative mathematics assessment practices stimulated these preservice teachers to reflect upon the links between mathematics assessment and instruction.

References

Borasi, R. (1990). The invisible hand operating in mathematics instruction: Students' conceptions and expectations. In T. J. Cooney's (Ed.) *Teaching and Learning Mathematics in the 1990s: 1990 Yearbook* (pp. 174-182). Reston, VA: NCTM.

Cooney, T. J., Badger, E., & Wilson, M. R. (1993). Assessment, understanding mathematics, and distinguishing visions from mirages. In N. L. Webb's (Ed.). *Assessment in the Mathematics Classroom: 1993 Yearbook* (pp. 239-247), Reston, VA: NCTM.

Kulm, G. (Ed.) (1990). *Assessing higher order thinking in mathematics.* Washington, DC: American Association for the Advancement of Science.

Moon, J. & Schulman, L. (1995). *Mathematics assessment and links with curriculum and instruction.* Portsmouth, New Hampshire: Heinemann.

National Council of Teachers of Mathematics (1995). *Assessment standards for school mathematics.* Reston, VA: NCTM.

Raymond, A. M. (1996). Teachers' beliefs about alternative mathematics assessment. *Paper presented at the Annual Meeting of the American Education Research Association,* New York.

Raymond, A. M. (in press). Inconsistency between beginning elementary teachers' mathematics beliefs and teaching practice. *Journal for Research in Mathematics Education.*

Stenmark, J. (1993). *Mathematics assessment: Models, myths, good questions, and practical suggestions.* Reston, VA: NCTM.

Thompson, A. (1992). Teachers' beliefs and conceptions: A synthesis of the research. In D. A. Grouws (Ed.) *Handbook of Research on Mathematics Teaching and Learning* (pp. 127-146). New York, NY: Macmillan Publishing.

Webb, N. L. (Ed.) (1993). *Assessment in the Mathematics Classroom: 1993 Yearbook.* Reston, VA: NCTM.